

CLAIMS

[1] A method of producing hydrogen by high temperature steam electrolysis for reducing electrolysis voltage by feeding steam to a cathode side and feeding hydrocarbon-containing gas to an anode side for reaction with oxygen ion, the cathode side and the anode side being provided in a high temperature steam electrolytic apparatus in which an electrolyzer is partitioned into the anode side and the cathode side using a solid oxide electrolyte as the diaphragm,

wherein

offgas discharged from the anode side of the electrolytic apparatus is admixed into the hydrocarbon-containing gas that is fed to the anode side of the electrolytic apparatus.

[2] The method of producing hydrogen according to claim 1, wherein the offgas from the anode side is admixed so that the sum of the steam and carbon dioxide stands in at least an equimolar ratio with respect to the number of moles as carbon of the hydrocarbon-containing gas fed to the anode side of the electrolytic apparatus.

[3] The method of producing hydrogen according to claim 1, wherein the offgas from the anode side is admixed so that the sum of the steam and carbon dioxide is approximately twice as the molar ratio the number of moles as carbon of the hydrocarbon-containing gas fed to the anode side of the electrolytic apparatus.

[4] The method of producing hydrogen according to any of claims 1 to 3, wherein the mixed gas of anode side offgas and the hydrocarbon-containing gas that is fed to the anode side of the electrolytic apparatus is, prior to coming into contact with the anode of the electrolytic apparatus, converted by a thermal reaction to a mixed gas whose main components are hydrogen and carbon monoxide and is thereafter brought into contact with the anode.

[5] The method of producing hydrogen according to any of claims 1 to 4, wherein oxygen or air is mixed into the anode side offgas from the electrolytic apparatus, the resulting mixed gas is admixed into the hydrocarbon-containing gas fed to the anode side of the electrolytic apparatus, and conversion is carried out, by the assist of the oxidation reaction heat of the hydrocarbon-containing gas, into a mixed gas whose main components are hydrogen and carbon monoxide.

[6] An apparatus for producing hydrogen, comprising: an electrolyzer partitioned by a solid oxide electrolyte diaphragm into an anode side and a cathode side; a conduit that feeds a hydrocarbon-containing gas to the anode side of the electrolyzer; and a conduit that feeds steam to the cathode of the electrolyzer,

and further comprising a conduit that admixes offgas discharged from the anode side of the electrolyzer into the hydrocarbon-containing gas fed to the anode side of the electrolyzer.

[7] The apparatus for producing hydrogen according to

claim 6, configured in such a manner that a catalyst layer is disposed in the conduit that feeds the mixed gas of hydrocarbon-containing gas and anode side offgas from the electrolyzer to the anode side of the electrolyzer, and the mixed gas of hydrocarbon-containing gas and anode side offgas is converted, prior to contact with the anode of the electrolytic apparatus, by a thermal reaction into a mixed gas whose main components are hydrogen and carbon monoxide.